FINAL

MEETING REPORT

MOAB MILLSITE GROUNDWATER SUBCOMMITTEE
Grand County Council Chambers, Moab, Utah
8:30A -5:00P, February 4, 2003

Meeting Attendees - See Attached List

Purpose

This report summarizes discussions at a meeting of the Moab Millsite Groundwater Subcommittee that was held at the Grand County Council Chambers in Moab, Utah on February 4, 2003. The meeting was held following a site visit on the previous day by the Subcommittee to provide an update of recent activities and characterization accomplishments at the site. During the site visit, Subcommittee members were given the opportunity to view core from recent exploratory boreholes and visit (1) riverbank backwater areas to observe the area of the planned Initial Remedial Action and a location where groundwater seepage from the riverbank was observed; (2) river floodplain areas where aquifer testing of the shallow and intermediate alluvial aquifer had been performed; and (3) the top of the tailings pile where proposed locations for the Interim Remedial Action components and subsidence effects from dewatering of the pile (via band drains) could be observed.

Prior to this meeting, the Department of Energy (DOE) provided Subcommittee members with Reports/Calculation Sets from its most recent (2002) investigations. These reports/calculation sets included Lithologic, Well Construction, and Field Sampling Results; Aquifer Test Data Phase II, Parts I and II; Determination of Distribution Ratios; Determination of Subpile Soil Concentrations; Alluvial Aquifer Vibrating Wire Piezometers; Tailings Seepage; and Soil Conductivity Investigation Results.

At the meeting, DOE provided additional handouts including "geologic logs and well completion information for the new shallow monitoring wells 455, 456, and 457; a paper print image of an "aerial photo dated 9/22/2001" showing layout of Initial Action elements/site plan; the "Interim Action System Site Plan" layout and cross section illustrating various components of the proposed system (Evaporation Pond, Evaporation Apron, Catchment Basin, and Well Field etc.); and a graph of "Provisional USGS Colorado River Flow Data @ Cisco, Utah: July – September, 2002."

Meeting Summary

The meeting began with participants introducing themselves and stating their affiliation for the benefit of new participants. DOE then briefly described recent EIS scoping activities. DOE indicated that six scoping sessions were held in nearby communities (Green River, East Carbon, Moab, Blanding, Crescent Junction,) and with Indian Nations

(Ute and Navajo) potentially impacted by the Moab Mill Site and tailings pile remedial options under consideration. Onsite options include cap-in-place and offsite options include removal of the tailings to potential repository sites or established facilities at Klondike Flats, Crescent Junction, White Mesa, and Blanding, Utah. DOE indicated that the comments by the various communities generally reflected a division between individuals who would see benefits (economic gain/jobs) in their local communities, thus favoring acceptance of millsite waste, and those who saw no benefit and/or possible harm in having the mill site waste transferred to a repository/process facility in or near their community. Moab participants in the scoping sessions were strongly in favor of an offsite disposal option. DOE indicated that the scoping comments they received would be summarized in the Draft EIS.

Interim Remedial Action

DOE began by summarizing the main elements of the "Interim Remedial Action" consisting of a groundwater pumping and evaporation remedial activity and pointing out that this is a separate activity and not tied in any way to the approved "Initial Action" for 2002 and subsequent years (as needed). Before discussing the Interim Remedial action, DOE touched briefly on the status of the Initial Action and reviewed its elements and its intent to remediate high ammonia concentrations in the Colorado River backwater areas during the May through July (post peak or falling river hydrograph) timeframes. This would be accomplished by dilution/flushing of backwater areas posing immediate threats to the young-of-the-year endangered fish species (primarily Colorado Pikeminnow) which frequent these backwater areas during the late spring and early summer. The Initial Action is being performed in close coordination with the U. S. Fish and Wildlife Service and was prompted by a U.S. Geological Survey study that identified threats to endangered species posed by discharge of ammonia from the Moab Millsite. The system would be activated at Colorado River flows from 12,000 cfs down to 5,000 cfs after a typical spring peak flow of 12,000 to 15,000 cfs. Due to the recent widespread drought in the Southwestern U. S., the 2002 peak flow of the Colorado River never inundated the backwater areas so the Initial Action could not be implemented in 2002 as planned. DOE indicated that they would alert Committee participants should the Initial Action be a "go" for 2003.

DOE then discussed the principal components of the Interim Remedial Action pump and evaporation system and the decisions leading to locating the evaporation system on the tailings pile (SE corner above "ring dike" sands). There appeared to be some past misunderstanding between DOE and representatives of the State of Utah about which floodplain delineations (25, 50 or 100 year) were applicable drivers for siting the remedial system and some discussion followed that other less restrictive siting options lower on the floodplain (e.g. in the Millsite area) were not intended to be precluded in previous discussions.

DOE pointed out that under Title I of UMTRA, they have significant flexibility to perform Interim Actions (are covered under a Categorical Exclusion vs. a NEPA process needing an EIS). The time period for Interim Actions is generally accepted as having a

5- year time limit, although Interim Actions have been known to extend well beyond that timeframe when site remedial activities warrant. DOE indicated this Interim Action will not be covered under the scope of the ongoing EIS, as those actions cannot begin until a Record of Decision is completed.

The Subcommittee and DOE then entered into a discussion of several Interim Action related issues ranging from (1) cost of the Interim Action ($1.4 million) and obtaining the greatest remedial value for the limited funding available (a prime objective of DOE's proposal); (2) flexibility to expand the system throughput (via more wells/increased well flows) in out years should their evaluation and fine tuning of the system during an operational shakedown period warrant; (3) the somewhat experimental nature of the evaporation apron design given its position on the relatively steep pile side slope (3/1:H/V); (4) dust control of the salts that will likely precipitate on the evaporation apron (DOE mentioned they had few problems with precipitate dust in other evaporation systems employed at their sites); (5) how DOE intends to adjust the system as it becomes operational to control solids/precipitates (intent is to keep solids off of side slopes/apron by regular washing down into catchment basin at toe and mucking out solids as necessary); (6) anchoring of the evaporation apron (HDPE sandbags on 20-foot centers); (7) the accumulation of salts and brines in the evaporation pond, stratification of liquids in this pond, potential for and impacts of any pond leakage and impact on operations as the circulating fluids increase in salinity; (8) likely state of the ammonia (ionized or unionized form), pH as a driver of the ammonia state and ammonia's anticipated fate (with some off-gassing); (9) thermal expansion of the 40 ml HDPE liners and control of evaporation apron wrinkles; (10) well field location (paralleling river immediately down gradient from pump test area and well spacing (10 in-line wells on 25 foot centers or 250 foot total length – note was made that this capture area is $1/8^{th}$ of the total 2000 foot width of ammonia contamination and that at this time there would be no attempt to capture a second ammonia hotspot located to the southwest); (11) plume/hot spot capture area would focus on the 600 to 1500 mg/l ammonia concentration (isochron) from the shallow silty sand fresher water portion of the aquifer; (12) projected pump rates (3 to 7 gpm range) yielding at the low rate an estimated 5-year capture volumetric of 180 million gallons of water having on average > 10 mg/l ammonia (pumped groundwater assumes a 5 year pumping duration at a conservative 30 gal/min extraction rate resulting in approximately ½ the calculated pore volume of the contaminated shallow silty sand aquifer in the zone of capture for this well field); and (13) the aesthetics of the project and its visual impacts (DOE acknowledged their focus to date had been on the technical elements and remedial benefits of the Interim Remedial Action and they have yet to address visual impacts of the project). The Subcommittee expressed concern with the large black evaporation apron that will be visible from a significant distance and the unnatural contrast it will likely exhibit with adjacent soils and precipitated salts.

A brief discussion then followed concerning the appropriate role of the Subcommittee in reaching consensus and making recommendations to DOE under the requirements of the Federal Advisory Committee Act (FACA). It was emphasized that per the requirements of FACA, the Subcommittee cannot make consensus recommendations to DOE; however individual Subcommittee members can submit comments and/or suggestions to DOE.

DOE indicated that all comments or suggestions by Subcommittee participants should be submitted to Joel Berwick, Moab Site Project Manager; these comments will be addressed by DOE as appropriate.

Summarization of Various Report Results

DOE then sequentially summarized results of each Report/Calculation Set and explained the principles of the technologies employed, types of data gathered, basis for the interpretations made, and the conclusions that could be drawn from the data.

1. **Aquifer Test Data Analyses (Phase II, Part 1 Oct 2002) and (Phase II Part 2 Jan. 2003)** - Several aquifer pump tests were conducted of the water table aquifer ("Silty Sand" unit) between August and November, 2002 to determine a feasible pumping rate that would capture the shallow contamination without up-coning the deep brine found in the underlying Sandy Gravel unit. Despite some equipment/valve failures shortening the lengths of some of the automated tests and possible well efficiency problems, DOE felt that most of the data were useful in meeting their objectives of evaluating brine upcoming, determining aquifer characteristics, and estimating well capture zones. As mentioned above, the highest ammonia concentrations were found in the underlying Sandy Gravel unit; however, it appears that the shallow "Silty Sand" unit has the contamination that impacts the river's backwater areas. DOE also commented that studies have shown that 10% of shallow aquifer likely discharges through uptake by phreatophytes and this should supplement any pumping in this area.

From these pump tests DOE determined:

a) Aquifer Hydraulic Conductivity - appears to range between about 25 and 80 ft/day (8.8E-3 to 2.8E-2 cm/sec) in the Silty Sand aquifer per Figure 1 (Phase I, Part 1 of Aquifer Test Data Analysis). It should be noted that this aquifer material is not in agreement with description of Sandy Gravel (GP-SP), Gravelly Sand (SP-GP), and Clayey Gravelly Sand (SP-SC) in the Monitoring (Pumping) Well Completion Log MOA01-0449 as described in Appendix A (taken from PZ1D2M).

b) Sustainable Pumping Rate - appears to be between 3-7 gal/min without causing the brine interface (35,000 TDS) to rise upward into the pumping well in the "Silty Sand." These pumping rates are a believed a good, representative first approximation but may be conservative (no upper pump rate limit evaluated) given the limited testing, heterogeneity of the aquifer, possible well efficiency problems, and limited design effort in the pump test well. DOE indicated that the optimum pumping rate will best be determined in the field during a shakedown period and results from operational testing of the system (observational method) over a longer period. It should be noted that pump test data reflected some inconsistencies between derived aquifer parameters from the short term and long term tests, the water table (unconfined) aquifer model and determined storage coefficients (approaching those of a confined aquifer),the described aquifer materials (largely sandy gravels and gravelly sands Vs "Silty Sands") and low well specific capacities. This suggests installation of the pumping well was problematic and test problems may have resulted from an inadequate gravel pack, and partial plugging of the gravel pack/screen during testing.

c) Well Spacing - for the pumping well field will be approximately 25 feet (relatively tight) in order to achieve the appropriate drawdown to capture the portion of the ammonia plume targeted. To cover this hotspot area of the ammonia plume (250 feet), DOE will install 10 pumping wells, which will result in a range of from 30 - 70 gpm of contaminated water that the evaporation system will need to manage. DOE has plans for an upgradient and a downgradient monitoring well cluster oriented perpendicular to the well line. Discussions by the Subcommittee indicated placing additional piezometers in line with/between the extraction wells may also be warranted as that oftentimes provides more valuable information in determining capture areas.

d) Hydraulic Connection: River - data collected during the test confirms that the water table in the "Silty Sand" is influenced by changes in river stage.

e) NH3 (N) in Groundwater South of River: Need for Additional Study - DOE informed the Subcommittee of recent groundwater samples collected from monitoring wells installed by Dr. Kip Solomon (University of Utah) and completed at the water table have shown ammonia concentrations on the Matheson Marsh side of the river at levels of about 2 mg/l. DOE indicated it will continue to study ammonia levels south of the river and try to determine the source of this newly discovered contamination.

f) Well Design – DOE indicated future well designs (selected sand pack grade, well screen slot size etc.) will be better engineered (e.g., based on sieve analysis of the shallow aquifer). Well efficiencies, specific capacities, and capture areas may be increased with less potential brine upconing in more formal engineering of the well design. Fine sand build up and removal during development may suggest a smaller grade of gravel pack and slot size is appropriate for these aquifer conditions to avoid mobilization and production of the fine sand through the gravel pack and its possible partial plugging.

g) Vertical Distribution of Contaminants – No additional aquifer profiling is planned to determine vertical distribution of contaminants beyond that determined from continued routine sampling of wells. As a general rule of thumb at the site:

upper freshwater aquifer ranges from < 5,000 to 15,000 mg/l TDS

transition zone ranges from 15,000 to 35,000 mg/l TDS

brine zone ranges from 35,000 to greater than 100,000 mg/l TDS

DOE indicated there are currently a total of 70 monitoring wells at the site including 17 wells on the pile.

2. **Alluvial Aquifer Vibrating Wire Piezometers (Dec. 2002 Report)** - DOE installed three nests of vibrating wire transducers (VWT) to measure vertical groundwater gradients at different locations near the river. At each nest, groundwater head was measured at about 20, 40, and 60 foot depths (bgs). Problems with flowing sands

between the 40 and 80 foot depth precluded their installation at the 20, 60 and 100 foot depths as initially planned. Because accurate depth placement of Vibrating Wire Transducers (VWTs) is an important component in head determinations, their placement in flowing sands can introduce some error. Other sources of potential introduced error include an incorrect zero reading made with the transducer for the site and improper adjustment or compensation for water of varying densities with depth. DOE explained how they minimized these sources of error during installation of the VWT probes. Three nests of 3 probes (depths) each were located: (1) upstream of Moab Wash, adjacent to the mill site area not far from the Atlas river water intake structure [Moab 4]; (2) downstream of Moab Wash at a point near the river's "backwater" area [Moab 3]; and (3) downstream of the pile beyond the site boundary owned by DOE [Moab 2]. DOE also installed a river gauge station at the former Atlas river intake structure. From the groundwater head data and river stage information collected at these nests and gauge station, DOE concluded:

a) River is a Losing Stream East of Site - DOE found that upstream of the site that the water levels in the river are above all the heads measured in the Moab 4 piezometer nest. This means that: (1) the Colorado River loses water from its channel to the shallow aquifer upon entering Moab Valley at the time (river stage) these measurements were made; and (2) that groundwater at the water table flows downward to deeper aquifer intervals. It appears that this losing stretch of the river extends from near the Moab Bridge to the vicinity of the confluence with Moab Wash. It is also important to note that: (1) the loss of river water to the aquifer is consistent with Dr. Solomon's recent findings of post-bomb tritium in groundwater under the Matheson Marsh; and (2) the downward hydraulic gradients in the aquifer may indicate that the dissolution of the Paradox Salt Formation may be largely driven by Colorado River water.

b) Horizontal Groundwater Flow - appears to exist in the shallow aquifer in the vicinity of the river's "backwater area" adjacent to the tailings pile (Moab 3). In this area, water levels in the river are approximately equal to the groundwater heads found at all 3 depths. This new preliminary finding contradicts previous DRC interpretations, and may suggest that it is possible for tailings pile contamination to travel under the river and discharge to the Matheson Marsh. This finding may be linked to the recent discovery of ammonia in shallow groundwater on the south side of the river.

c) River is Gaining Stream Downstream of Pile - downstream of the pile the DOE piezometer nest (Moab 2) showed that all 3 depth intervals had higher head than the Colorado River, thus indicating upward flow of groundwater to the river (i.e., the river here is a gaining stream). The full extent of this gaining stretch is currently undefined, but it should extend at least from the DOE piezometer nest Moab 2 downstream to the Portal. This interpretation is also consistent with the shallower occurrence of brine (near water table) in this area. Figure 3.10 of a previous ONRL report (January 1998) showed chloride in excess of 40,000 mg/l in this area.

From this new DOE information, it appears that: (1) additional study needs to be done here to better assess the potential for tailings contamination to travel southeastward under the Matheson Marsh; this information is critical to understanding the location of potential points of contaminant exposure and to identify potentially exposed populations; and (2) dissolution of the Paradox Salt in the subsurface under Moab Valley may be largely driven by the Colorado River via seepage losses and vertically downward groundwater gradients near Moab Bridge, coupled with the vertically upward flow gradients and stream gains near the Portal.

The Subcommittee encouraged DOE to continue its investigations in this matter, and provided several comments on the direction and type of equipment that might be used to better evaluate seepage losses and gains from the river and determine vertical hydraulic gradients in the aquifer system.

3. **Tailings Seepage Report (Jan. 2003)** – DOE applies the "jelly donut" conceptual model in understanding the spatial relationship of the slimes (central jelly filled area) and sands (outer ring of donut) resulting from hydraulic filling of the tailings pile/pond area during operation of the mill. Density contrasts caused the coarser sand fraction to fall out nearest the outfall pipe while the fine slime fraction migrated and accumulated near the center of the tailings pile/pond. An underlying tenant is that the tailings pile dewaters through gravity drainage of sands, and the consolidation of slimes occurs by release of positive pore pressure under their own weight. Meteoric water falling onto the slimes area will cause some infiltration. However, its rate of entry into the tailings slimes will be controlled by: (1) the low permeability of the slimes which would divert the water and cause it to accumulate at the upper surface of the slimes; and (2) removal of this water either by evaporation at the exposed slimes surface, or evaporation at the DOE evaporation pond (after capture by the horizontal "wick" drain laterals which divert it to the collection sump).

   While positive pore pressures exist in the slimes, the leachate is released via three mechanisms: (1) discharge to the surface through the "wick" drains; (2) lateral travel along sandy/silty interbeds which leads to discharge to the higher permeability sands at the outer margin of the slimes, followed by vertical seepage to the water table; and (3) slow dissipation of the pore pressure, in combination with gravity, that allows downward migration of the leachate through the slimes (again, this vertical flux is controlled by the vertical permeability of the slimes). Thus infiltration and flow is most likely to occur in the "ring dike" sands.

   In recent years, dewatering of the slimes was facilitated by adding a soil surcharge to the top of the pile and installing wick/band drains so that the increased positive pore pressure would drive fluids to the surface, more rapidly dewater the pile and reduce volumes of contaminated pore fluids discharged to groundwater. DOE elevation survey data indicates that part of the slimes area on the topslope has subsided in some areas by as much as 8 feet since installation of the wick drains. However the average subsidence across the pile area underlain by slimes is 3 feet. Average subsidence of the slime area is expected to reach 8 feet once the pile reaches equilibrium and gravity drainage of existing fluids is complete. Initially the wick drain system delivered about 10,000 gal/week to the collection manhole. Today the system delivers only about 2,000 gal/week and is expected be completed in approximately 1 year when slime pore pressure can no longer offset heads in the wicks (band drains). At this point, tension conditions or negative pore pressures will exist in the slimes that will decrease the vertical flux discharge at the center of the pile.

To estimate future pile consolidation, seepage releases, volumes of leachate captured by the band drains, and time required to complete pile consolidation, DOE ran infiltration, water balance, and consolidation models based on a four-fold division of the pile materials (sand, sand slimes, slime sands, and slimes) assuming materials were at full saturation at start. Certain simplifying assumptions were made that may or may not represent actual field conditions. From these predictions, DOE concluded that: (1) the NE corner of the slimes area is currently the most over-pressured (i.e., the greatest additional subsidence will occur in this area); (2) by May of 2000, 36% of the settlement of the slimes had occurred; (3) the wick drain system currently only intercepts about 10% of the total drainage from the pile with the rest lost through gravity drainage; (4) the pile consolidation will continue to deliver leachate to the surface via band drains for about 1 more year; and (5) thereafter, the pile will drain leachate only via gravity drainage to the underlying aquifer (15 to 20 more years to reach consolidation/equilibrium), unless additional soil surcharge is added to the topslope.

Subcommittee comments were that the seepage predictions of DOE would be extremely hard to quantify in the field given the lack of information regarding moisture storage in the pile and the limited ability to measure flow thru the vadose zone under the pile. Also, any attempt made to convert the seepage flux estimates to rates of contaminant mass discharge or loading on the aquifer would be rendered unreliable given the much greater variability/uncertainty in many other related factors, including historic contamination caused by pre-closure operation of the pile, variations in aquifer Kd partitioning coefficients, and fluctuating water tables, groundwater flow directions, and local gradients. DOE did indicate there was site operational data available from 1978 indicating 35,000 to 40,000 TDS for fluids being discharged to the pile. Past mounding in the pile of these denser fluids may have historically caused more vertical (downward) gradients beneath the pile creating a mechanism for the deeper distribution of contaminants (into the brine) than is apparent now. It should be pointed out that it is not the mounding of leachate in the pile that caused the higher vertical gradients in the past, but it is due to the combined effect of operational wastewater storage on the top of the pile and the higher density of these fluids.

DOE assumed various cover permeabilities for the cap-in-place option. Using a cover design of 5×10^{-7} cm/sec. permeability is consistent with a very high (conservative) infiltration of 6"/yr. through the cover and into the pile. This resulted in constant drainage being reached within 6 years and a 27 gpm zero or net flux at steady state.

4. **Determination of Subpile Soil Concentrations Report (Jan. 2003)** - in this report DOE compared vertical profiles of soil contaminant concentrations at several locations at the facility. Background concentrations were examined in soils found below the water table in boring 434 (located north of Hwy. 191) with vadose and saturated soil concentrations found under the tailings pile. From these data, DOE concluded that: (1) some tailings contamination has migrated to the subsoils under the pile for a distance of about 10 feet; (2) radium-226 contamination of the subsoil appears to extend to a depth of only 6 feet below the tailings; and (3) re-wetting of the tailings, particularly along the pile's southern margin, has the potential to mobilize contaminants and re-distribute them to vadose soils and into groundwater.

   Subcommittee comments included: (1) borings selected by DOE on the pile were located at the margin of the slimes area where contaminant concentrations in the tailings may be lower than areas found in the center of the slimes area; (2) background soil samples collected in boring 434 were taken below the water table and may not be representative of vadose background conditions, particularly for redox sensitive contaminants; (3) the low iron concentrations (relative to background soils) seen in subpile soils is likely evidence of past exposure to highly reducing leachates from the pile that would have leached out native iron; (4) comparisons of subpile soil concentrations to the EPA soil screening levels for groundwater protection (20 Dilution Attenuation Factor [DAF]), is inappropriate in that the 20 DAF criteria is only applicable to contaminated sites of less than 0.5 acre; and (5) careful examination should be made of the subpile contaminant concentrations to determine if any preference exists for a certain lithology and/or grain size in the alluvial sediments (fines).

5. **Determination of Aquifer Distribution (Kd) Ratios Report (Dec. 2002)** –As contaminated groundwater migrates through soils and rocks, understanding some of the transfers between the solid and liquid phases is important. This ratio determines the rate of contaminant transport relative to the velocity of the groundwater. In this report, soil samples collected from below the water table in boring 434 (located north of Hwy. 191) were exposed to a synthetic leachate to determine soil-water partitioning coefficients for the site. Soils tested from this boring included 3 samples from the uppermost Silty Sand unit (lithologies = silty sand, clayey silt, and sand), and 1 sample from the underlying Sandy Gravel unit (lithology = sandy gravel). The DOE artificial leachate was designed to represent a November 19, 2000 groundwater sample of uranium and total ammonia from Atlas well ATP-3, located north of the pile. From the testing, DOE determined: (1) the soil Kd for uranium at the site is 2.06 ml/gm and 1.88 ml/gm for total ammonia; (2) test results indicate that the uranium Kd appears to be reliable; (3) the total ammonia Kd appears to be unreliable due at least in part to chemical mechanisms, other than adsorption, that removed ammonia mass from the experiment; and (4) Kd values determined for the gravelly samples were significantly lower than the other fine grained soils. Consequently, individual Kd values should be determined for the fine grained soils.

   Subcommittee comments included: (1) care needs to be taken in preparation of synthetic leachates for total ammonia in that pH increases made in preparation of the sample or during testing could have significantly converted NH4 dissolved in solution to gaseous NH3 that could have been lost from the sample; and (2) Kd calculations made in Tables 1 and 2 of the report appear to be in error. DOE agreed to re-examine this report and revise as necessary.

6. <u>**Soil Conductivity Investigation Results Report (Nov. 2002)**</u> - DOE used Geoprobe equipment to direct push 11 borings into the subsurface across the site. During installation of each boring, soil conductivity measurements (resistivity logs) were made to determine the approximate depth to the brine interface. From this study of soil conductivity, DOE determined: (1) results in boring 358 provide a reasonable correlation with groundwater quality profile sampling from nearby well PW-01, in that both showed the brine interface (TDS ~ 35,000 mg/l) to be at a depth of about 55 ft bgs; (2) a similar transition from fresh to more saline groundwater was seen on the eastern end of the mill site area in boring 364 (7,910 to 19,220 mg/l TDS) at a depth of about 45 ft bgs; (3) increasing TDS concentrations with depth were apparent in boring 362 found north of the former mill office building and south of Hwy. 191; and (4) low TDS concentrations (TDS < 10,000 mg/l) are apparent at the water table in 7 other borings installed around the mill site and north of the pile.

   Subcommittee comments included: (1) discrepancy in soil conductivity log for boring 362 where the total depth (TD) is listed as 45 ft bgs in the Attachment 3 figure, but elsewhere the report lists the TD as 55 ft bgs; and (2) no explanation provided in the report for anomalous conductivity highs in the vadose zone for at least 3 wells (358, 364, and 365) which could have been caused by man-made sources such as buried metallic debris.

7. <u>**Lithologic, Well Construction, and Field Sampling Results Report (Oct. 2002)**</u> - This DOE report provided detailed geologic logs and well completion details for a number of monitoring wells and piezometers installed at the site in 2002. During the meeting, an updated interpretation was provided for the bedrock formation found at depth (99 ft bgs) in well 431 (now interpreted as Moenkopi Formation). DOE also provided geologic logs and well completion diagrams for 3 new shallow alluvial wells installed since October, including well 455 (existing bedrock well 433), well 456 (next to existing bedrock well 434), and well 457 (near deep alluvial well 444 and deep bedrock well 435).

   Subcommittee comments included: (1) presence of several key lithologies in the subsurface gravels at the site clearly indicate they were deposited by the Colorado River (e.g., oil shale from Green River Formation [Mahogany Ledge Member], Precambrian gneiss and schist from Westwater Canyon, and igneous diorite porphyry from the LaSal Mountains; (2) ten (10) of the 14 wells and piezometers installed in 2002 encountered Colorado River deposited gravels in the subsurface at the site; (3) six (6) of the 14 borings where river gravels were found are located north of the tailings pile or along the north boundary of the mill site area; suggesting the Colorado River has migrated freely and extensively across the site over geologic time; (4) The current estimate based on radiocarbon dating of wood found in one core is that subsidence of the site area due to subsurface salt removal is 2+ feet per thousand years (minimum); and (5) The recent deeper borings through the pile also indicate the previous interpreted arcuate fault and occurrence of a shallow bedrock bench of the Glen Canyon Group beneath the tailings pile is no longer a viable subsurface geologic model as once thought. Rather, the pile appears to rest on alluvial deposits of the Moab/Courthouse Wash which overlie deposits of the Ancestral Colorado River to at least a depth of 400 plus feet. However, it should be noted that the three borings through the pile did not extend to a depth of 400 feet below the original land surface. The deepest of these borings, No. 439, found near the south edge of the pile's topslope, had a TD of 304 feet. Taking into account that the base of the tailings was found at a depth of 87 feet, it is clear that this boring only extended about 217 feet below the original land surface. As such, it appears that the bedrock shelf appears to be deeper than once supposed or that the vertical contact between this shelf and the accumulated river gravels is found north of boring No. 439.

DOE indicated that geologic cross-sections were being constructed for the site using the recent drilling and core data and these illustrations should provide a framework for further discussions of area subsidence and migration of the Colorado River.

8. **Closing Subcommittee Comments** - at the close of the meeting, Subcommittee members added several comments, including:

   a) Future Role of Subcommittee - some members wondered about redundancy in meetings should certain agencies choose to become Cooperating Agencies with DOE in the new upcoming EIS process. However, it was agreed that this forum provides a free exchange of technical information that includes entities that may never elect to be EIS "Cooperators." Therefore, the group will continue to operate as before in accordance with the requirements of FACA. DOE also acknowledged they saw benefits to their technical efforts through an exchange and discussion of ideas with the Subcommittee in such meetings.

   b) Groundwater - Surface Water Interaction (GW-SW) Report - from the reports provided, it was clear that previous conceptual models regarding the interaction of the shallow aquifer with the Colorado River have to be dramatically revised. DOE agreed to conduct additional studies in this area and prepare a new groundwater – surface water report.

   c) Unresolved Action Items from the June, 2002 Meeting – two DOE action items remain open from the June, 2002 Subcommittee meeting, including: (1) research on uptake of uranium mill groundwater contaminants by tamarisk; and (2) detailed geologic cross-sections for the Moab Mill site. DOE explained that work on these two items is on-going, and that they will be completed shortly.

   d) Other Possible Groundwater Remediation Technologies - DOE should examine all possible groundwater remediation technologies to ensure a complete evaluation. One possible technology that might be examined may be deep well injection disposal of contaminated groundwater collected by the pump and treat system. Other discussions surrounded use of an infiltration trench to work in conjunction with the groundwater extraction system to provide dilution of contaminants in the shallow aquifer and an additional hydraulic barrier to the flow of contaminants toward the river. DOE indicated that this option remained on the table as they evaluated to what degree implementation of the proposed pump and evaporation system would meet the Interim Action objectives.

e) DOE will keep the Subcommittee apprised of its plans to implement the Initial and Interim Remedial Actions.

9. Next Meeting: No specific meeting date was determined. The date of the next Subcommittee meeting will be a function of DOE report completion, implementation of remedial actions, and/or other groundwater-related activities or accomplishments at the site.

ATTENDEE LIST

Moab Millsite Groundwater Subcommittee
Grand County Council Chambers, Moab, Utah
February 4, 2003, 8:30A-5:30P

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